92-34 (1-96)

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

TECHNICAL SERVICES DIVISION
RESEARCH & DEVELOPMENT SECTION

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EXPERIMENTAL CONSTRUCTION 92-34

FIELD TRIAL OF GRAVEL STABILIZATION METHODS
ROUTE 1, CYR-VAN BUREN, MAINE

3RD INTERIM REPORT

INTRODUCTION

This experimental construction project was developed, designed, and inspected by personnel from the University of Maine, Civil Engineering Staff The experimental area was constructed on and as a part of Project 2586 00 This was a complete reconstruction project 3 54 km (2 2 miles) in length The experimental section contained 6 experimental base types and is 310 m (1020 feet) in length The experimental section began at station 1028+00 and ended at station 1038+20 The test section consisted of 60 m (200 foot) segments of soil-cement, asphalt-stabilized, and calcium chloride-stabilized materials, as well as two control sections and one 6 m (20 foot) untreated section The stabilized and control sections were located as follows

Soil-Cement Stabilized	STA 1028+00 to 1030+00
Modified Subbase Control	STA 1030+00 to 1032+00
Asphalt Stabilized Section	STA 1032+00 to 1034+00
Untreated Section	STA 1034+00 to 1034+20
Calcium Chloride Stab Section	STA 1034+20 to 1036+20
Standard Subbase Control	STA 1036+20 to 1038+20

Construction on this project started in September 1990 and was completed in the summer of 1991 A construction report "Experimental Construction 92-34" was written in December 1991 which provided a background of stabilization agents, their uses, advantages and disadvantages This report also provided preliminary design results as well as test results obtained during the construction phases In addition to the test results a plan for long term monitoring was also included in Appendix G of the Construction Report Some of the features to be monitored are rutting, and serviceability such as roughness and overall performance Strength measurements using a Road Rater was also suggested Most of the evaluations can be performed with the ARAN vehicle and the Road Rater Long term monitoring of the calcium chloride section is specifically mentioned For this phase it was recommended that test holes be bored every 5 years to determine the extent, if any, of calcium chloride leaching

RESULTS

This third interim report covers the period of time from January 1995 through December 1995 During this period of time a full series of tests were obtained including ARAN rutting and roughness, Road Rater deflection data, elevations and cross sections, crack survey and test holes to determine calcium chloride leaching

ARAN Rut Depth Study

The rut depth results are presented in Table 1 Some of the rut depth readings from the previous years had to be recalculated because the wrong areas were used for each section The changes in rut depths were minimal with the exception of the 1994 southbound lane which had the inner and outer wheelpath readings reversed

The rut depths on this project are continuing to increase The previous years show the inner wheelpath having greater rut depths It appears that outer wheelpath rut depths are increasing in all sections The calcium chloride section seems to be experiencing the lowest rut depths and the soil cement section the highest It was noted in the 2nd interim report that the high rut depths for the soil cement section may have been due to the strong structural condition of the stabilized base causing the asphalt pavement to rut The 1995 rut depths ranged from 2 5 mm to 7 0 mm (0 100 to 0 275 inch) This is normal for most roadways of this age

ARAN Roughness Study

The International Roughness Index (IRI) is presented in Table 2 As with the rut depth data the 1993 IRI had to be recalculated because the wrong areas were used

This was the first year that roughness was collected in the southbound lane so there are no comparison data

According to Table 2, roughness is slightly increasing in the northbound lane with the poorest ride occurring on the asphalt stabilized base The overall values for the test sections are still considered "smooth" A smooth classification are values between 0 to 190 inches per mile, medium between 190 to 320 inches per mile, and rough are values in excess of 320 inches per mile

Cross Section Study

When the project was completed in the summer of 1991 cross section levels were taken by UMO personnel Within a very short period of time cross section levels were also taken by MDOT personnel for the purpose of obtaining final quantities

These two sets of data were within reasonable conformity with each other except for the first cross section at Station 1028+50 This particular cross section showed a difference in elevations of approximately 0 091 m (0 3 feet) As a part of the research study, cross section levels were taken again in the summer of 1992 after one year of elapsed time The settlement comparisons between the MDOT readings show very little movement as compared to the UMO readings To avoid confusion it was decided to use the 1991 MDOT elevations as a standard reference

MDOT took elevation readings in 1991 every 15 m (50 ft) from station 1028+00 to 1038+00 at offsets of 4 and 7 m (12 and 22 ft) as well as centerline In 1992 readings were taken every 30 m (100 ft) from station 1028+50 to 1037+50 at CL, 4 and 7 m (12 and 22 ft) offsets In 1993 and 1995 readings were taken every 15 m (50 ft) from station 1028+00 to 1038+00 at CL, 1, 2, 3, 4 and 7 meter (3, 6, 9, 12 and 22 foot) offsets Most of the movement occurred between 4 m (12 ft) and 7 m (22 ft) left and right of centerline The greatest difference of 0 06 m (0 20 ft) occurred at station 1030+00 4 m (12 ft) left and 0 03 m (0 1 ft) at station 1029+00 4 m (12 ft) right The remaining movement for the paved shoulder area was 0 02 m (0 06 ft) or less There was limited movement in the roadway of 0 01 m (0 04 ft) or less with the exception of one reading of 0 02 m (0 06 ft) at station 1029+00 2 m (6 ft) left The overall test area experienced very little movement after four years of traffic and weather

Visual Evaluation

Visual inspection of the roadway revealed 7 transverse cracks, 3 more than reported in the 2nd Interim Report There was pavement joint separation on centerline from station 1028+00 to 1028+50 and 1029+80 to 1037+30 and shoulder joint separation between station 1032+20 to 1034+20 on the right and 1034+50 to 1036+50 on the left The calcium chloride section had some longitudinal cracking between wheelpaths in the left lane between station 1035+10 to 1036+20 In addition, there was asphalt flushing in five areas of the right lane outer wheelpath four areas 3 m (10 ft) in length and one area in the Asphalt Stabilized section 17 m (55 ft) in length

Chloride Content Study

This was the first year of testing to determine to the extent of chloride leaching Random test sites were selected avoiding the Road Rater test areas and the first and last 5 feet of the $CaCl_2$ stabilized area The samples were taken on centerline and between wheelpaths only A total of eight samples were extracted by means of coring the 6" pavement and hammering a 24" by 1 1/2" I D split spoon sampler into the stabilized base and aggregate base to a depth of 30" below finished grade

The results presented in Table 3 show there was a considerable amount of chloride leaching into the aggregate base material

Perhaps samples of the subgrade should be included in the next scheduled test date

Structural Evaluation Using Road Rater Deflections

Strength measurement readings were obtained through the use of Road Rater deflections The first 2 columns with 76 mm and 120 mm (3" and 4 3/4") pavement thickness were deflection results taken during construction These were for informational purposes and will not be discussed in this report The criteria used in developing the structural parameters were as follows A 20 year design life, for a truck traffic rate of 110 18K loads per day, on a "till" type of soil subgrade The average of four deflection tests per subbase type are presented in Table IV

The readings obtained on 6/14/94 and presented in the first two Interim reports were calculated using a 10 year design life A 20 year design life was used to recalculate the results for this Interim report

Examination of the structural information in Table IV indicates that the "standard" and "modified" subbase sections are performing the same The calcium chloride section appeared to be structurally weaker than the other sections The asphalt stabilized section appeared to be stronger than the three granular subbase sections The soil-cement section had the strongest stabilized base with very little change in readings from previous years Although the deflection readings are higher for 1995, the test site was structurally sound

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Distribution B

Other Available Documents

- Construction Report December 1991
- 1st Interim Report May 1993
- 2nd Interim Report February 1995

TABLE I
PHYSICAL PROPERTIES
AVERAGE RUT DEPTHS (Inches)

	SOUTHBOUND LANE		NORTHBOUND LANE	
	Outer WP	Inner WP	Inner WP	Outer WP
1991				
Standard Subbase	Missing	Missing	0 038	0 063
Calcium chloride	"	"	0.050	0 088
Untreated	"	"	0 000	0 100
Asphalt Stab	"	"	0 100	0 050
Modified Subbase	"	"	0 063	0 025
Soil Cement	"	"	0 088	0 043
1992				
Standard Subbase	0 080	0 040	0 073	0 036
Calcium chloride	0 033	0 008	0 108	0 050
Untreated	0 000	0 000	0 200	0 100
Asphalt Stab	0 067	0 025	0 175	0.075
Modified Subbase	0 092	0 025	0 108	0 025
Soil Cement	0 083	0 033	0.145	0 091
1993				
Standard Subbase	0 150	0 100	0 150	0 025
Calcium chloride	0 000	0 000	0 125	0 050
Untreated	0 000	0 000	0 200	0 100
Asphalt Stab	0 050	0 025	0 250	0 125
Modified Subbase	0 025	0.025	0 150	0 075
Soil Cement	0 100	0 175	0 200	0 150
1994				
Standard Subbase	0 150	0 125	0 150	0 050
Calcium chloride	0 100	0 025	0 175	0 075
Untreated	0 200	0 000	0 200	0 000
Asphalt Stab	0 100	0 025	0 250	0 100
Modified Subbase	0 100	0 025	0 200	0 175
Soil Cement	0 100	0 200	0.250	0 200
1995				
Standard Subbase	0 200	0 175	0 150	0 150
Calcium chloride	0 150	0 150	0 150	0 175
Untreated	0 100	0 200	0 200	0 200
Asphalt Stab	0 200	0 150	0 225	0 200
Modified Subbase	0 200	0 125	0 200	0 200
Soil Cement	0 200	0 200	0 275	0 200

TABLE II
PHYSICAL PROPERTIES
INTERNATIONAL ROUGHNESS INDEX (Inches Per Mile)

	1991		1992		1993		1994		1995	
SUBBASE TYPE	SBL	NBL	SBL	NBL	SBL	NBL	SBL	NBL	SBL	NBL
Standard Subbase	M	42 23	M	M	M	57 66	M	M	40 67	46 11
Calcium Chloride	M	47.09	M	M	M	43 07	M	M	61.35	53 61
Untreated	M	M	M	M	M	M	M	M	M	M
Asphalt Stabilized	M	70 97	M	M	M	37 88	M	M	68 22	72 15
Modified Subbase	M	58 09	M	M	M	63 40	M	M	61 53	73 09
Soil Cement	M	55 67	M	M	M	69 98	M	M	82 05	56 03

M represents Missing Data

TABLE III
CHLORIDE CONTENT

Samples taken on 9/12/1990

Sample Number	Sample location		CL (mg/kg)	
1	1034+50 L	top	2900 0	
2	1034+50 L	bottom	2500 0	
3	1035+00 R	top	2500 0	
4	1035+00 R	bottom	2000 0	
5	1035+50 L	top	5700 0	
6	1035+50 L	bottom	2500 0	
7	Untreated aggregate #1			6 8
8	Untreated aggregate #2			9 5
9	Untreated aggregate #3			23 0
10	Fıeld CBR A 1035+25 CL		4700 0	
11	Fıeld CBR B 1035+75 R		3500 0	
12	Fıeld CBR C 1035+00 L		3500 0	
13	Fıeld CBR D 1035+50 L		4100 0	
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Stabılızed base ave CL			3390 0	
Aggregate subbase ave CL				13 1

Samples taken on 8/15/1995

Sample Number	Sample Location	Depth (BFG)	CL (mg/kg)	
1	1035+60 6' L	6 - 12"	365 0	
2	1035+60 6' L	12 - 30'		623 0
3	1034+75 6' L	6 - 12"	432.0	
4	1034+75 6' L	15 - 24"		708 0
5	1034+50 6' R	6 - 12"	273 0	
6	1034+50 6' R	15 - 24"		520 0
7	1034+90 6' R	6 - 12"	124 0	
8	1034+90 6' R	15 - 27"		521 0
9	1035+10 6' R	6 - 12"	77 8	
10	1035+10 6' R	15 - 27"		100 0
11	1035+10 CL	6 - 12"	89 0	
12	1035+10 CL	15 - 27"		136 0
13	1035+15 CL	6 - 12"	40 6	
14	1035+15 CL	15 - 27"		37 7
15	1036+05 CL	6 - 12"	573 0	
16	1036+05 CL	12 - 24"		536 0
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Stabılızed base ave CL			246.8	
Aggregate subbase ave CL				397 7

(BFG) = below fınıshed grade

TABLE IV
CONSOLIDATED ROAD-RATER RESULTS
@ CYR PLANTATION / VAN BUREN
UMO EXPERIMENTAL BASE STUDY

Thickness	3"	4 3/4"	6"	6"	6"	6"	6"
Date Measured	09/28/90	05/21/91	08/06/91	09/16/92	09/08/93	06/14/94	07/12/95
	DEFLECTION # 1 SENSOR (MILS) (Not temperature corrected)						
STANDARD B	4 49	3 55	2 04	1 47	1 35	1 36	1 75
MOD SUBBASE	4 15	3 83	2 01	1 44	1 35	1 52	1 88
ASPH STAB B	4 18	2 79	1 60	1 24	1 11	1 36	1 56
CaCl2 STAB	4 21	3 20	2 05	1 54	1 47	1 43	1 82
SOIL CEMENT	2 30	2 52	1 37	1.05	1 03	1 18	1 36
**	COMPUTED SUBGRADE VALUE						
STANDARD B	1 33	2 00	5 93	18 70	10 47	9 44	10 78
MOD SUBBASE	1 77	1 46	5 20	16 88	10 31	10 19	9 25
ASPH STAB B	1 69	3 37	9 43	20 10	16 95	19 17	9 09
CaCl2 STAB	1 86	2 68	5 84	16 68	9 78	10.99	6 42
SOIL CEMENT	8 70	4 27	15 92	20 83	30 18	22 35	16 77
**	EFFECTIVE PAVEMENT THICKNESS (Inches)						
STANDARD B	0 00	2 14	5 41	4 00	5 48	5 53	4 13
MOD SUBBASE	0 00	1 49	5 57	4 13	5 62	4 95	4 52
ASPH STAB B	0 00	2 48	5 62	4 74	5 61	4 09	5 11
CaCl2 STAB	0 03	2 77	5 71	4 14	5 66	4 99	4 77
SOIL CEMENT	2 41	2 96	5 42	5 49	4 95	4 65	5 56
**	PAVEMENT REQUIRED (Inches)						
STANDARD B	9 30	7 54	3 89	1 09	2 40	2 26	2 33
MOD SUBBASE	8 39	8 33	4 07	1 09	2 41	2 10	2 66
ASPH STAB B	8 47	5 45	2 43	0 85	1 20	0 74	2 39
CaCl2 STAB	8 51	6 56	3 93	1 48	2.78	1 91	3 35
SOIL CEMENT	2 98	4 65	1 31	0 58	0 17	0 52	1 32
**	OVERLAY REQUIRED (Inches)						
STANDARD B	9 30	5 40	-1 52	-2 91	-3 08	-3 27	-1 80
MOD SUBBASE	8 39	6 84	-1 50	-3 03	-3 21	-2 85	-1 85
ASPH STAB B	8 47	2 97	-3 19	-3 90	-4 41	-3 35	-2 72
CaCl2 STAB	8 48	3 79	-1 78	-2 66	-2 89	-3 08	-1 42
SOIL CEMENT	0 57	1 69	-4 11	-4 90	-4 78	-4.14	-4 24

** Temperature corrected deflections were used in calculations